

Stephani in 1886 gives a list of 169 which even then was not quite complete. The species of *Metzgeria* have doubled since Lindberg wrote his monograph which is quoted as giving eleven species. We note the absence of three of Mitten's genera, *Conoscyphus*, *Mastigopelma* and *Plectocolea*. *Cronisia* Berkeley, which Lindberg changed to *Carringtonia* because he did not believe in anagrams,¹³ is also omitted from the series. So also are some of Trevisan's innovations,¹⁴ but possibly the less said of these the better. The widely scattered literature has rendered this work by Mr. Evans specially difficult.¹⁵ A number of generic names will have to be replaced on grounds of priority whenever we have a sufficiently stable system on which to make the shift. One hundred and seventeen genera are included, of which 87 belong to the Jungermaniaceæ. And yet the text-books persist in regarding *Marchantia* as a representative liverwort!—LUCIEN M. UNDERWOOD.

The psammophilous flora of Denmark.

Prof. Warming presents a sketch of the peculiar vegetation of the dunes and sandy plains in Denmark,¹⁶ arranged according to their occurrence in the following zones: (I) "The psammophilous *Halophyta*" from the sandy strand; (II) "the vegetation characterized especially by the grass *Psamma*" from the dunes along the coast; and (III) "the *Weingærtneria*-vegetation," where this grass prevails, and which has been observed on the sandy banks along the coast or in the interior of the country.

In the first of these "formations" the characteristic is the *Halophyta*, which live here on a loose, sandy and salt-bearing soil, the surface of which is very dry and warm during certain seasons. This vegetation does not form any dense growth, since the consistency of the soil is very variable. The plants belong to two categories; annuals or perennial herbs mostly with widely creeping rhizomes, while trees and shrubs are almost absent. Among the annuals are *Cakile*, *Salsola*,

¹³ *Cronisia* was based on *Corsinia* which it resembled.

¹⁴ VITTORE TREVISAN: Schema di una nuova classificazione delle epatiche. Mem. R. Ist. Lomb. di Scienze e Lettere, ser. III, IV, (1877).

¹⁵ There is needed a classified bibliography of the Hepaticae and on this we have been working for several years and hope to reach publication of the first part (author catalogue) in a few months.

¹⁶ EUG. WARMING: De psammophile Formationer i Danmark. Videnskap. Meddel. Naturh. For. Kjöbenhavn 1891.

species of *Atriplex*, *Senecio viscosus*, *Salicornia* and the variety *salina* of *Matricaria inodora*. The perennials are represented by *Alsine peploides*, *Triticum junceum*, *Festuca rubra*, *Lathyrus maritimus* and the very rare *Carex incurva* and *Petasites spuria*. Only a few perennial herbs without creeping rhizomes are recorded from this locality, such as *Crambe*, *Eryngium* and *Mertensia*, all of the species "maritima."

What the author has called the "Psamma-formation," the second zone, includes the vegetation of the dunes which are most typically developed along the coast, where they give the landscape its very singular appearance. They are barren hills exposed to raging storms, and with a vegetation always very poor and monotonous. The plants must be able to resist a living burial in the moving sands. But as a matter of fact the formation of these dunes is actually due to their growth. *Psamma*, *Elymus* and *Triticum* make the foundation, holding the sand together by means of their roots and rhizomes; gradually a hill forms by the continuous deposits of shifting sand. When these plants have succeeded in forming the dune, others soon follow, represented by *Weingaertneria*, *Calluna*, or, in some cases, by *Hippophaë*, and the former growth of *Psamma* gradually dies out.

It is stated that a single tuft of *Psamma* has caused the formation of a dune about twenty meters high. This plant is, therefore, better fitted for resisting sand burial than any other. It not only does not hurt it to be covered entirely by the sand; its growth seems really stimulated, the ascending shoots stretching themselves so as to reach the surface and the sunlight.

Elymus arenarius is also a valuable plant for making stable the sand, although it is not nearly so important as *Psamma*, and does not seem to thrive well before the sand has been fixed. A few other grasses might be mentioned as belonging to this vegetation, namely, *Festuca arenaria* and some species of *Triticum*. The spiny, silvery-grayish shrub, *Hippophaë rhamnoides*, thrives here, and forms almost impenetrable thickets, due especially to its rapid propagation by root-shoots. The roots have been observed to reach a length of about five meters and to go down in the ground to a depth of about thirty cm., developing dense tufts of shoots.

The third zone is characterized by *Weingaertneria* along

with several other plants, which first occupy the soil, prepared by the "Psamma-vegetation," and which, to some extent, contribute to the stability of the sand; for instance, *Sedum acre*, *Taraxacum*, *Sonchus*, *Leontodon*, *Carex arenaria*, *Thymus*, etc. Some of them propagate by root-shoots, while others have widely creeping rhizomes, e. g., *Carex arenaria*, or runners above ground. *Weingaertneria* differs from these by its cespitose growth which is due to a profuse development of shoots from the axils of the lowest leaves. The young flowers are well protected by the large leaf-sheaths, as is also the case with *Psamma*.

There are besides these types a few others, which propagate by a multicipital root; such plants are very common in the fixed sand, and several species are enumerated.

These perennial plants have meanwhile prepared the soil for another growth which consists of annuals and biennials; but the immigration of these depends upon two conditions: the sand must have become entirely stable, and its vegetation must not be too dense.

The dune has now gradually changed its character as to soil and vegetation, and it is not seldom that it finally becomes a heath, producing a growth of *Calluna* and *Empetrum*.

Among the peculiarities of these sand plants the author enumerates and describes several singular anatomical features. It seems as if the adaptation for regulating the transpiration were the main object, and that end is gained by diminishing the leaf-surface. Several of these plants show, therefore, narrow or very short leaves; the stomata become less numerous and often confined to deep furrows or cavities, a common feature in the Gramineæ. The leaves, or their divisions, are often raised more or less vertically; a covering of hairs or wax is very common, so as to protect the stomata; while in some others a thick cuticle is characteristic. Species of succulent plants are comparatively few in number.—THEO. HOLM.